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SHROUDED ATTRIBUTES, CONSUMER MYOPIA, AND INFORMATION SUPPRESSION IN COMPETITIVE MARKETS

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SHROUDED ATTRIBUTES, CONSUMER MYOPIA, AND INFORMATION SUPPRESSION IN COMPETITIVE MARKETS*

XAVIER GABAIX AND DAVID LAIBSON

October 3, 2005

Abstract

Bayesian consumers infer that hidden add-on prices (e.g. the cost of ink for a printer) are likely to be high prices. If consumers are Bayesian, firms will not shroud information in equilibrium. However, shrouding may occur in an economy with some myopic (or unaware) consumers. Such shrouding creates an inefficiency, which firms may have an incentive to eliminate by educating their competitors' customers. However, if add-ons have close substitutes, a "curse of debiasing" arises, and firms will not be able to profitably debias consumers by unshrouding add-ons. In equilibrium, two kinds of exploitation coexist. Optimizing firms exploit myopic consumers through marketing schemes that shroud high-priced add-ons. In turn, sophisticated consumers exploit these marketing schemes. It is not possible to profitably drive away the business of sophisticates. It is also not possible to profitably lure either myopes or sophisticates to non-exploitative firms. We show that informational shrouding flourishes even in highly competitive markets, even in markets with costless advertising, and even when the shrouding generates allocational inefficiencies.

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I. Introduction

When consumers make mistakes, firms will try to exploit those mistakes.[1] In some markets, competitive pressure may undermine such exploitation.[2] For example, competing firms could reveal the exploitation and win over customers. In this paper, we identify when such competitive debiasing will and will not occur. We study the market for add-ons — e.g. printer cartridges — and develop an idea first proposed by Glenn Ellison [2005, section V.C], who suggests that some consumers do not think about add-ons when they buy a base good. We formalize this consumer error and determine when competition will lead to debiasing.

Our paper is motivated by the observation that firms choose to hide information from consumers. For example, banks prominently advertise the virtues of their accounts, but the marketing materials do not highlight the costs of such an account which include ATM usage fees, bounced check fees, minimum balance fees, etc. Banks could compete on these costs, but they instead choose to shroud them. Indeed, many bank customers do not learn the details of the fee structure until long after they have opened their accounts.

Cruickshank [2000] reports results of a U.K. Treasury survey that investigates the origins of high fees in the U.K. banking sector. Half of the respondents report having no information about the fees for common financial services at their own bank.[3] The report concludes that "In the markets to supply banking services to personal customers [...] few consumers are aware of the terms and conditions of the products they hold, pointing to significant information problems."

The printer market operates in a similar way. Printer manufacturers advertise the low price of their inkjet printers, but do not compete on the principal cost of ownership: patented ink cartridges that cost ten times more than the printer itself over the life of the product. Hall [2003] reports that only 3 percent of printer owners claim to know the printing cost at the time they buy their printers. Indeed, printer manufacturers try to make these costs invisible. For example, the printing cost

[1] A growing literature models markets in which sophisticated firms interact with consumers who may have psychological biases. For example, see DellaVigna and Malmendier [2004], Gabaix, Laibson and Li [2005], Glaeser [2005], Heidhues and Koszegi [2005], Jin and Leslie [2003], Koszegi and Rabin [2006], Mullainathan and Shleifer [2005], Oster and Morton [2005], Shui and Ausubel [2004], Spiegler [2004], and Ellison [forth.] for an overview.

[2] See Becker [1957] and Laibson and Yariv [2005].

[3] Respondents were asked "How accurately do you feel you know the charge for services on your account?" Response categories included: "Exactly," "Roughly," "Not at all," and "Did not apply." About half of respondents choose "Not at all."

of personal Hewlett-Packard deskjet printers is not easily accessible on the company's web site. From each printer's homepage, one must follow a complex sequence of links to uncover the cost of printing. Such shrouding does not reflect exogenous communication costs. The information about printing costs is further away from the printer homepage — using the click metric — than any other information about the printer.

At first glance, shrouding add-on prices seems like a natural marketing strategy. However, if consumers are all rational (or aware), shrouding should actually hurt the bank or printer manufacturer, because rational consumers will expect the worse from a firm that shrouds [Milgrom 1981]. Any information that is hidden in the fine print — or excluded from marketing materials altogether — is not likely to be favorable to consumers. Rational consumers will infer that hidden prices are likely to be high prices. Such reasoning creates an incentive for information revelation and unravelling of shrouding. Indeed, all firms choose to unshroud their prices in equilibria with rational consumers.

We show that shrouding behavior will arise if "myopic" consumers incompletely analyze the future game tree. Some economists believe that such shrouding cannot survive [Shapiro 1995], arguing that competitive firms should educate other firms' customers, offer those customers efficient pricing schemes, and consequently win their business. In contrast, we show that the existence of myopic consumers creates equilibrium shrouding that is immune to such competitive pressure.

We derive conditions under which competitive price cutting and educational advertising will *not* occur in equilibrium. We show that debiased consumers prefer to give their business to firms with *high* shrouded prices because these sophisticated consumers end up with a subsidy from policies designed for myopic customers [DellaVigna and Malmendier 2004, 2005].[4]

To develop intuition for our results, consider a hotel room that costs Hilton $100 to supply. Suppose that *all* consumers are initially myopic (i.e., they do not think about add-ons when they plan a hotel visit). When such a customer stays at Hilton, she ends up paying $20 to purchase add-ons like parking, telecommunications, room service, etc. Without loss of generality, assume that these add-ons cost Hilton nothing to provide. In a competitive market, Hilton will then advertise "Hilton's rooms cost only $80," neglecting to mention the costly add-ons that effectively raise its revenue. In competitive equilibrium, Hilton's costs ($100) equal Hilton's total revenues ($80+$20).

[4]In DellaVigna and Malmendier [2004, 2005] cross-subsidies arise from self-control problems. Naive consumers who do not recognize their self-control problems cross-subsidize sophisticated consumers who do.

Now consider another hotel chain, called Transparent, that is picking a business strategy. Transparent could tell consumers about the shrouded add-ons that consumers pay for at Hilton.[5] Transparent could advertise, "Watch out for add-on prices at our competitors. Tranparents's add-ons are all free." Naturally, if Transparent did this, they could not subsidize their room fees with add-on revenue. An aggressive transparency strategy would be to charge \$100 for rooms and nothing for add-ons.

Unfortunately, this efficient pricing scheme might not attract any customers. Once consumers *understand* the high mark-up strategy of Hilton, consumers might prefer to *stay* at Hilton and simply substitute away from add-on consumption. A "sophisticated" customer anticipates the marked up add-ons at Hilton and avoids buying many of them (e.g., she brings a cell phone instead of relying on the hotel phone, she takes a taxi instead of renting a car that requires parking, etc.). Suppose that the economic cost of such substitution is \$10. In this case, Hilton's newly educated customers prefer to stay at Hilton rather than defecting to marginal cost pricing at Transparent. Hilton's educated customers receive a \$100 room for \$80 and only have to endure a little inconvenience (worth \$10) to avoid buying Hilton's overpriced add-ons. So Transparent's education campaign hurts Hilton — which sells fewer add-ons — but helps Hilton's customers, who are taught to substitute away from add-ons.[6] After the educational advertising campaign, nobody defects to Transparent, even though Transparent has marginal-cost pricing. Hilton is a better deal for sophisticated consumers. Hence, Transparent's unshrouding/advertising campaign does not attract any business. The present paper generalizes this example.[7]

This example also illustrates the curse of debiasing. This curse occurs whenever debiasing makes a consumer less profitable for the debiasing firm. Sophisticated consumers tend to be less profitable because they know how to avoid unecessary costs. In such cases, firms do not have an incentive to pursue debiasing and competition will not lead consumers to behave rationally. There are many markets in which firms do not have an incentive to educate their own customers or even the customers of their competitors. Consider the illustrative example above. Debiased Hilton customers, get a \$100 hotel room for a price of \$80 plus \$10 of inconvenience. Hence, the debiased consumer has no reason to defect to Transparent. Accordingly, Transparent (or Hilton) has no

[5] For concreteness, assume that all consumers receive and understand this message and assume that advertising is free. However, the example works no matter what fraction $0 < \lambda \leq 1$ of consumers get the message and no matter what it costs to place such advertisements.

[6] Of course, Hilton would like to screen out such sophisticated consumers, but this is typically not possible.

[7] In the notation of section II, $c = 100$, $\widehat{c} = 0$, $\mu = 0$, $e = 10$, $\alpha = 0$, $\lambda \in (0, 1]$, $p = 80$, $\widehat{p} = \overline{p} = 20$.

incentive to educate Hilton's myopic consumers in the first place. Debiasing a consumer is good for the consumer and bad for both firms. Neither firm has an incentive to do it.[8]

In essence, we show that there are two kinds of exploitation. Firms exploit myopic consumers. In turn, when consumers become sophisticated, they take advantage of these exploitative firms. Finally, when sophisticated consumers exist, firms cannot rid themselves of them.[9] In equilibrium, nobody has an incentive to deviate except the myopic consumers. But the myopes do not know any better and often nobody has an incentive to show them the error of their ways. Educating a myopic consumer turns him into a (less profitable) sophisticated consumer who prefers to go to firms with loss-leader base good pricing and high-priced (but avoidable) add-ons. Hence, education does not help the educating firm.

This mechanism applies to a wide range of markets. An educated banking customer gets the benefit of a $50 gift for opening an account and avoids paying some of the fees that snare myopic consumers. An educated credit card holder gets convenience, float, and miles and avoids paying interest charges and late payment fees.[10] An educated home printer buyer gets a loss-leader price and avoids paying for frequent cartridge replacements (by printing in black and white instead of color, printing in draft mode, or printing fewer large jobs at home).[11] In such markets educated consumers prefer to stick with the firms that feature high add-on prices, since these firms have loss-leader base-good prices, and the educated consumer can partially substitute away from the overpriced add-ons.

Our analysis shows why high add-on markups will persist in markets with numerous competitors and *free* advertising. This prediction distinguishes our model from standard search models, which

[8] Another example of the curse of debiasing occurs in mutual funds. If a mutual fund company explains that stock picking is not effective and that fees are the primary predictable component in risk-adjusted returns, a newly educated consumer will decide to buy an index fund – a very competitive, and relatively unprofitable, segment of the market. Educating the consumer transforms him into an unprofitable consumer, and for-profit companies will not want to implement such education [Gabaix, Laibson and Li 2005].

[9] In the example above, Hilton cannot drive away educated consumers without also losing its myopic consumers.

[10] In recent years, a new shrouding ploy has emerged. For example, Chase offers 0 percent Annual Percentage Rate (APR) on transferred balances. In a footnote in their ads the company acknowledges that "we apply payments to introductory balances before balances with higher APRs [...] Learn more about rates, fees, and other cost information by reviewing Pricing & Terms." In the fine print of Pricing & Terms, Chase reports, "You authorize us to allocate your payments and credits in a way that is most favorable or convenient for us. For example, you authorize us to apply your payments and credits to balances with lower APRs (such as promotional APRs) before balances with higher APRs." Sophisticates can take advantage of this scheme by transferring a balance to Chase and never using the Chase card to make a purchase. In contrast, myopes may fail to realize that they can only repay their new credit card charges (which may accumulate at a high interest rate) after they have repaid their introductory balance (which accumulate at a 0% interest rate). We thank Robert Barro for pointing out this example.

[11] A sophisticated consumer could also purchase the add-on from a third party, at some transaction cost. This is why base-good firms often hinder such third party transactions. See Salop [1993] and Hall [2003] for examples.

imply that firms have an incentive to disseminate information about their products and choose not to do so only if such dissemination is costly (e.g., Butters [1977]; Salop and Stiglitz [1977]; and Stahl [1989]).[12] We identify conditions under which firms will choose *not* to advertise and hence *not* compete by lowering add-on prices, even when advertising is free. This explains why industries with nearly costless marginal information dissemination still shroud their add-on prices. In a search model with only rational consumers, firms will choose to disclose all of their information if they can do so costlessly. In our model, with enough myopic consumers, shrouding is the more profitable strategy.

As we have explained, our explanation for add-on shrouding and high markups depends on the presence of myopic consumers.[13] In contrast, many authors have developed rational actor models that explain why add-ons have high markups. However, these rational models do not explain why firms *gratuitously* shroud add-on prices. Two types of explanations for high mark-ups figure prominently in the literature: high *exogenous* search costs[14] and an inability to commit[15].

Ellison [2005] proposes a rational price-discrimination model in which add-on pricing enables firms to charge high demand consumers relatively more than low demand consumers.[16] In Ellison's model, exogenous search costs make it costly for consumers to observe add-on prices. High add-on markups raise profits by facilitating price discrimination. However, Ellison points out that high markups will not be sustainable when information transmission is inexpensive (i.e., when search costs are exogenously small, see Stole [2005]). To handle this case, Ellison suggests an extension that would incorporate unsophisticated consumers who would not buy a base-good *if* they anticipated its total cost including the add-on. We work out a closely related model that incorporates myopia and different degrees of competition. In our setting, unsophisticated consumers simply fail to take the add-on into account when comparing products. Hence, they only compare the prices

[12] This can be viewed as the key difference between modelling bounded rationality as search costs [e.g., Salop and Stiglitz 1977] and modelling it directly as failure to anticipate an attribute as in our model. In the search cost approach, if firms can costlessly educate the consumers, they will do so because consumers are Bayesian. If a firm goes out of its way to sustain high search costs, Salop and Stiglitz consumers will rationally infer that it has something to hide. So, if advertising costs are low, all firms reveal information to consumers.

[13] In contrast, Ayres and Nalebuff [2003] propose that high add-on prices are partially due to *myopic* choices on the part of firms, which would make more profits if they had low add-on prices and consequently developed a good reputation.

[14] Search-cost models imply that firms choose high add-on prices because it is exogenously costly for consumers to observe add-on prices before they buy the base good [Diamond 1971; Lal and Matutes 1994; Stahl 1989; Hortacsu and Syverson 2004]. In contrast, our model generates *voluntary* information suppression.

[15] The literature on commitment shows that firms choose high add-on prices if firms cannot commit to add-on prices at the time the base good is sold (Borenstein et al. [1995], Farrell and Klemperer [2005], Klemperer [1987]). In our analysis however, we consider the polar case in which firms can commit to an add-on price.

[16] See Ellison and Ellison [2004] for related empirical analysis.

of base-good across firms, instead of comparing the total prices (base-good plus add-on). When add-ons are made salient — e.g. through advertising — our newly educated consumers do not exit the market, but instead make an more informed choice among the available goods. Our analysis identifies conditions under which no firm has an incentive to educate consumers in this way.

Section II defines a shrouded attribute and presents an equilibrium analysis of a market with discrete demand for add-ons. Section III discusses extensions, including the general case with continuous demand for add-ons. Section IV discusses the measurement and regulation of shrouded markets. Section V concludes. All proofs are presented in appendices.

II. Shrouded Attributes: Definitions and a Model

We analyze a market in which firms can shroud attributes of their products. These shrouded attributes are not taken into consideration by some potential customers. For example, a bank might suppress information about minimum balance fees in the bank's marketing materials. Some consumers will neglect to consider such fees when picking a bank. For the purposes of our model, a shrouded attribute is a product attribute that is hidden by a firm, even though the attribute could be nearly costlessly revealed.[17] The Hewlett-Packard decision to omit the deskjet price per page on their web site is an example of such information suppression.

Shrouded attributes may include surcharges, fees, penalties, accessories, options, or any other hidden feature of the ongoing relationship between a consumer and a firm. We divide this list into two mutually exclusive categories: (avoidable) *add-ons* and (unavoidable) *surcharges*.

The analysis in this paper primarily discusses add-ons, the first type of shrouded attribute. Add-ons are complementary goods that consumers have the option to avoid. For example, hotel guests can avoid paying telephone charges if they instead use cell phones. Likewise, hotel guests can avoid paying for room service meals by finding local restaurants. Both hotel phone use and hotel room service complement a hotel stay. Such complementary (voluntary) goods are referred to as *add-ons*.

In our modeling, we distinguish between a "base good" and the shrouded attribute. In the preceding example, the base good is a hotel room and the shrouded attributes are hotel services. We assume that myopic consumers pick a base good without considering shrouded attributes.[18]

[17] More generally, communication costs need to be low enough so that unshrouding would occur in an equilibrium with rational consumers.

[18] A consumer can compare prices of closely located four star hotels on a web travel site (e.g., Orbitz), without

II.A. Timeline and overview of (discrete demand) shrouding game

We now discuss a model with discrete demand for the add-on. We postpone the general case — i.e., continuous demand — to section III.B. We start by providing an overview of the timing of the discrete demand game. We discuss the details of the game after the timeline.

Period 0:

- *Firms* decide to make information about the add-on *shrouded* or *unshrouded.* This is a binary choice. Unshrouding a price is equivalent to advertising that price. To make unshrouding/advertising maximally attractive to the firm, we assume that unshrouding is free.[19]
- *Firms* pick prices for a base good (p) and an add-on ($\widehat{p}$).

Period 1:

- *Sophisticated* consumers (fraction $\alpha < 1$ of the population) always take the add-on and its price into consideration.[20] If information about the add-on is shrouded, sophisticates form Bayesian posteriors about the unobserved add-on.
- *Myopic* consumers (fraction $1 - \alpha$ of the population) only consider the add-on if they directly observe the add-on information. When the add-on is shrouded, myopes do not observe the add-on information. When the add-on is unshrouded, fraction $\lambda \in (0, 1]$ of myopes observes the add-on information.
- Consumers choose a firm.
- Consumers can initiate costly behavior (effort cost e) that enables them to substitute away from future use of the add-on.

Period 2:

- Consumers observe the add-on price (if they have not observed it already) and are given an opportunity to purchase the add-on. Consumers who previously engaged in costly substitution behavior have a lower incentive to purchase the add-on.

observing the hotels' add-on pricing schedules. See Ayres and Nalebuff [2003].

[19] We revisit this assumption in subsection III.D.

[20] We assume $\alpha < 1$ because the analysis is of interest only when there are myopic consumers. Also, when $\alpha = 1$, many combinations of p and $\widehat{p}$ are equivalent, as the equilibrium determines only $p + \widehat{p}$.

II.B. Details of the shrouding game

To motivate the model, we will discuss the example of a bank, but the model applies to any setting in which firms offer add-ons to their customers.

Period 0: In period 0, banks set and potentially shroud prices. Let p represent the price of a base good, which in our example is the price of opening a bank account. Let $\widehat{p}$ represent the price of an add-on. In our example, violating the minimum balance is an add-on service with price $\widehat{p}$.[21] Both p and $\widehat{p}$ are chosen by each bank in period 0. Without loss of generality, we assume that banks have zero marginal cost of opening an account or of having an account-holder violate the minimum balance threshold.

Each bank may shroud or unshroud its minimum balance fee. If the bank chooses to shroud $\widehat{p}$, the minimum balance fee will not be seen by potential consumers. For example, $\widehat{p}$ may be hidden in fine print or published in an obscure location. One can think of this action as creating a gratuitous search cost that is large enough so that few consumers bother to see the add-on price. Without loss of generality, we assume that shrouding implies that no consumer observes the add-on price.

The bank may alternatively costlessly advertise $\widehat{p}$, thereby revealing it to *all* sophisticated consumers and to λ fraction of myopic consumers, with $0 < \lambda \leq 1$. Without loss of generality we assume that λ is fixed. We allow λ to be weakly less than unity to reflect the possibility that myopes — who may not initially recognize the value of information about the add-on market — may overlook that information even when it is made available. We define *informed myopes* as the myopes that have seen (and noted) unshrouded information about the add-on. Informed myopes behave exactly like sophisticated consumers. Analogously, we define *uninformed myopes* as those myopes that have not seen information about the add-on. Hence, when information is unshrouded by one or more firms, a fraction λ of myopes is informed — and therefore become sophisticated — and a fraction $1 - \lambda$ of myopes is uninformed. Hence unshrouding by any firm increases the sophistication of the pool of potential customers shared by all firms.[22]

Period 1:

[21] In US banks, a typical minimum balance fee is $10 and applies in months when an account balance falls below some minimum that is strictly greater than zero. A minimum balance fee is distinct from an overdraft fee, a bounced-check fee, or an insufficient funds fee. Those fees apply to cases in which customers would like to use funds that they do not have in their accounts. Naturally, the model discussed here applies to those fees as well.

[22] Assuming that the impact of advertising is more local would not change our results.

Consumers pick a firm from which to buy the base good. *Sophisticates* always take the existence of the add-on into consideration, forming Bayesian posteriors about the add-on when its price is shrouded. *Myopes* only consider the add-on if it is revealed to them.

For a consumer, taking account of the add-on generates two sources of value. First, a consumer can consider add-on pricing when choosing a firm. Second, a consumer who anticipates or observes high add-on prices can exert costly effort $e > 0$ in period 1 and thereby substitute away from the add-on. For example, a consumer who faces a high minimum balance fee could transfer balances into the account or cut back withdrawals so that the fee is less likely to be invoked.

We assume that add-on fee $\widehat{p}$ is effectively bounded above by $\overline{p} > e$.[23] For example, if a customer is forced to pay a high fee, the customer might terminate her relationship with the bank or lodge a complaint. Legal and regulatory constraints also limit the penalties/fees that banks can charge. Finally, $\overline{p}$ could represent the cost of a last minute consumer intervention that enables the consumer to avoid purchasing the add-on.

We assume that sophisticates and *informed* myopes are aware of the add-on fee. Hence, sophisticates and informed myopes will exert substitution effort e if $e < E\widehat{p}$.[24]

Let x_i represent the *anticipated* net surplus from opening an account at bank i less the anticipated net surplus from opening an account at the best alternative bank (ignoring idiosyncratic taste differences). Throughout the paper we use starred variables to represent the (symmetric) prices set by other firms. We analyze symmetric equilibria in this paper.[25]

For sophisticated consumers,

$$x_i = \left[-p_i - \min\left\{E\widehat{p}, e\right\}\right] - \left[-p^* - \min\left\{E\widehat{p}^*, e\right\}\right],$$

where $E\widehat{p}$ and $E\widehat{p}^*$ are the rational expectations about the add-on price of the firm, and its competitors, respectively. When the add-on information is unshrouded, expectations are equal to the true value of the add-on price. When the add-on information is shrouded, sophisticated consumers solve the Bayesian equilibrium to calculate $E\widehat{p}$ and $E\widehat{p}^*$.[26]

[23] If the add-on is unavoidable ($e > \overline{p}$) and consumers are not all sophisticated ($\lambda < 1$, $\alpha < 1$) then the proof of Proposition 1 shows that there is a unique sequential equilibrium, which has Shrouded Prices and $p = -\overline{p} + \mu$, $\widehat{p} = \overline{p}$.

[24] We assume local risk neutrality throughout the paper. Also, it is important that informed myopes behave like sophisticates.

[25] Technically, our equilibrium is a sequential equilibrium, as detailed in the preamble of the proof of Proposition 1.

[26] We commit some abuse of language here. When the add-on information is shrouded, the sophisticated consumers' beliefs are part of a consistent assessment (i.e. a strategic profile and a belief system), in particular they anticipate perfectly the price that the firm charges in equilibrium.

Myopic consumers fall into two classes. When add-on prices are unshrouded, a fraction λ of myopes becomes *informed.* These informed myopes behave just like sophisticates with $E\widehat{p} = \widehat{p}$. A myope that was educated by firm i becomes sophisticated in his behavior vis-a-vis all firms. However, even when add-on information is unshrouded, a fraction $1 - \lambda$ of myopes remains *uninformed.* When add-on information is shrouded, all myopes are uninformed.

For uninformed myopes,

$$x_i = -p_i + p^*.$$

Uninformed myopes neglect the add-on when deciding where to open their bank account. Likewise, uninformed myopic consumers do not consider exerting substitution effort e in period 1.

Let $D(x_i)$ represent the probability that a consumer opens an account at bank i. Recall that x_i represents the *average anticipated* net surplus from opening an account at bank i less the *average anticipated* net surplus from opening an account at the best alternative bank. The demand function D is strictly increasing, bounded below by zero, and bounded above by one. Appendix 1 presents a microfoundation of the demand function. The demand function allows us to flexibly parametrize the degree of competion in the industry, via the quantity $\mu = D(0)/D'(0)$, which will turn out to be equal to the average profit per consumer. In particular, perfect competition corresponds to $\mu = 0$.

Period 2:

Consumers observe the add-on price (if they have not observed it already) and are given an opportunity to purchase the add-on. Consumers who have engaged in substitution in period 1 do not purchase the add-on. All other consumers purchase the add-on at price $\widehat{p}$.[27]

II.C. Symmetric equilibrium

We now characterize the symmetric sequential equilibrium of this game.[28] Let α represent the share of sophisticated consumers in the marketplace. The following proposition shows that firms will choose high markups in the add-on market. In the Shrouded Prices Equilibrium, firms will choose markups that are so high that the sophisticated consumers substitute out of the add-on market.

[27] Alternatively, we could assume that uninformed myopes buy the add-on in period 2 *without* observing the price: i.e., the myopes believe that the unobserved add-on price is low enough to justify the purchase.

[28] The proof of Proposition 1, in Appendix 2, provides the details of the strategies and beliefs.

Proposition 1 Let

(1) $$\alpha^{\dagger} \equiv 1 - e/\overline{p}$$

and

(2) $$\mu = D(0)/D'(0).$$

If the fraction of sophisticated consumers α is less than $\alpha^{\dagger}$, there exists a symmetric equilibrium in which firms shroud the add-on price. Call this the Shrouded Prices Equilibrium. The prices of the base good and the add-on are respectively:

(3) $$p = -(1-\alpha)\overline{p} + \mu$$

(4) $$\widehat{p} = \overline{p}.$$

In this equilibrium only myopes purchase the add-on. The allocation is inefficient since sophisticates substitute away from the add-on.

If the fraction of sophisticated consumers α is greater than $\alpha^{\dagger}$, there exists a symmetric equilibrium in which firms do not shroud the add-on price. Call this the Unshrouded Prices Equilibrium. The prices of the base good and the add-on are respectively:

(5) $$p = -e + \mu$$

(6) $$\widehat{p} = e.$$

In this equilibrium all consumers purchase the add-on, so the equilibrium is efficient.

In each of these equilibria, the beliefs of sophisticated consumers and educated myopes are $\widehat{p} = \overline{p}$ for the add-on price at a firm that shrouds, independently of its base good price. Also, the total profits of the industry are μ.

The proof is in Appendix 2.

Proposition 1 characterizes a Shrouded Prices Equilibrium[29] in which firms choose inefficiently high markups in the add-on market and choose to *shroud* those add-on prices.[30] In the Shrouded Prices Equilibrium, firms set $\widehat{p}^* = \overline{p}$, though the marginal cost of producing the add-on is 0. This equilibrium is inefficient since the sophisticates pay effort cost e to substitute away from add-on consumption (see subsection II.D below).

Our model reproduces the well-known result that high markups for the add-on are offset by low or negative markups on the base good.[31] This is easiest to see when the market is approximately competitive (i.e., the demand curve is highly elastic, and hence μ is close to zero). In a relatively competitive market with small μ, the base good is always a loss leader with a negative markup: $p^* \approx -(1-\alpha)\overline{p} < 0$ or $p^* \approx -e < 0$. The model implies that the add-on will be the "profit-center" and the base good will be the "loss leader."[32]

Our model also predicts equilibrium shrouding, as conjectured by Ellison [2005]. Other previous authors have conjectured that the availability of inexpensive advertising would drive down aftermarket prices and eliminate shrouding. For example, Shapiro [1995] describes the inefficiency caused by high markups in the aftermarket and then observes that competition and advertising should drive them away.

> Furthermore, manufacturers in a competitive equipment market have incentives to avoid even this inefficiency by providing information to consumers. A manufacturer could capture profits by raising its [base-good] prices above market levels (i.e., closer to cost), lowering its aftermarket prices below market levels (i.e., closer to cost), and informing buyers that its overall systems price is at or below market. In this fashion, the manufacturer could eliminate some or all of the deadweight loss, attract consumers by offering a lower total cost of ownership, and still capture as profits some of the eliminated deadweight loss. In other words, and unlike traditional monopoly power, the manufacturers have a direct incentive to eliminate even the small inefficiency caused

[29] It is easy to see that if $\alpha + \lambda(1-\alpha) < \alpha^\dagger$ and there is a small cost of unshrouding, then the Shrouded Prices Equilibrium is the unique symmetric sequential equilibrium. When λ is large enough another equilibrium exists. Specifically, when $\alpha < \alpha^\dagger < \alpha + \lambda(1-\alpha)$, the Shrouded Prices and Unshrouded Prices Equilibria both exist.

[30] For empirical applications,we reexpress Proposition 1 in the case where the marginal costs c and $\widehat{c} \leq e$ are not zero. In this case, if $\alpha < \alpha^\dagger$, $p = c - (1-\alpha)(\overline{p} - \widehat{c}) + \mu$, and if $\alpha > \alpha^\dagger$, $p = c + \widehat{c} - e + \mu$. The value of $\widehat{p}$ does not change.

[31] See the literature review in the present paper and in Ellison [2005].

[32] In many seemingly competitive markets the price of the base good is typically set below its marginal cost (e.g., printer, hotel, car rental, financial services), while the price of the add-on is set well above its marginal cost (printer cartridge, hotel phone call, gas charge, minimum balance fee).

by poor consumer information [Shapiro 1995, p. 495].

In the Shrouded Prices Equilibrium, Shapiro's intuition about inefficiency applies, but his anticipated unshrouding effects are overturned by other forces. In general, high markups in the aftermarket do *not* go away as a result of competition or advertising.

Why doesn't Shapiro's unshrouding effect arise? Shapiro conjectures that firms will compete by advertising low add-on prices, thereby attracting consumers by highlighting the benefits of efficiently priced add-ons.

However, Proposition 1 shows that this competitive effect is overturned by a "curse of debiasing." Specifically, educated consumers would prefer to frequent firms with high add-on prices that they can *avoid* rather than defecting to firms with marginal cost pricing of both the base good and the add-on.

Again consider the illustrative case of perfect competition, $\mu = 0$. If a sophisticated consumer gives her business to a firm with shrouded market prices, the sophisticated consumer's surplus will be:

$$\begin{aligned} \text{sophisticated surplus} &= -p - e \\ &= (1-\alpha)\,\overline{p} - e \\ &> (1-\alpha)\,\overline{p} - (1-\alpha)\,\overline{p} \\ &= 0. \end{aligned}$$

By contrast, if the sophisticated consumer gives her business to a firm with zero markups on both the base good and the add-on, the sophisticate's surplus will be exactly 0.[33] So the sophisticated/educated consumer is strictly better off at the firm with shrouded prices (and high add-on markups), than deviating to the firm with marginal cost pricing.

This preference for the firms with high mark-ups reflects the fact that the sophisticated consumers are subsidized by pricing policies designed for uninformed myopic consumers. Educating uninformed myopes enables them to get more value out of their relationships with *high* markup firms. After education, myopes anticipate the high add-on prices, and hence substitute away from add-ons while still enjoying loss leader prices on the base good. The newly educated consumers

[33] The particular value of a 0 surplus depends on the choice of normalization. If we shift all utilities by a factor V, the surplus will be V.

benefit from the "free gifts" and avoid the high fees.[34]

This generates the curse of debiasing. A firm does not benefit by debiasing uninformed myopic consumers. Newly educated consumers (i.e., sophisticates) are not profitable to any firm. Specifically, sophisticates prefer to patronize — and in particular, exploit — firms that offer loss-leader prices on base-goods.

This intuitive analysis explores pricing deviations in which a firm tries to educate and attract myopes from other firms (using low markups as the lure). Naturally, equilibrium analysis must also analyze deviations in which a firm with high markups tries to drive away (money-losing) sophisticates. Naturally, both deviations must be considered in the proofs of Proposition 1.

In summary, the presence of uninformed myopic consumers incentivizes firms to adopt pricing schedules that have the unintended consequence of subsidizing sophisticates. Making more myopes sophisticated will not help any firm. Because of this curse of debiasing, no firm has an incentive to educate myopes, even when education is costless.

II.D. Welfare

We now provide a welfare analysis of the Shrouded Price Equilibrium and highlight the inefficiency of this equilibrium.[35]

Proposition 2 In the Shrouded Prices Equilibrium, the social welfare loss is $\Lambda = \alpha e$. Sophisticated consumers are $\overline{p} - e$ units better off than myopic consumers. In the Unshrouded Prices Equilibrium, there is no inefficiency and all consumers are equally well-off.

Proof of Proposition 2. The social welfare loss is proportional (with factor e) to the fraction of agents that exerts costly effort e to avoid consuming the add-on. Recall that the firms can produce the add-on at 0 marginal cost. In the Shrouded Prices Equilibrium, all of the sophisticated agents exert effort e, so the deadweight loss is αe. Also, as sophisticates pay e to avoid buying the add-on, and myopes pay $\overline{p}$, sophisticates are $\overline{p} - e$ better off than myopes.

In the Unshrouded Prices Equilibrium, no consumers exert costly effort, and all purchase the add-on, which is produced at 0 marginal cost. There is no efficiency loss.□

[34] In Proposition 1, indeed, one needs $\lambda > 0$, but otherwise the specific value of λ does not matter. The reason is clear from the proof. Sophisticates are less profitable than myopes, so after unshrouding an increase in the number of sophisticates, caused by $\lambda > 0$, reduces total profits.

[35] As often in welfare economics, the pricing distortion is likely to have greater redistributional effects than net efficiency losses.

Since the add-on can be produced at zero *social* cost,[36] it is socially efficient for the add-on to be consumed. If a consumer substitutes away from the add-on (at effort cost e), then an equilibrium is socially inefficient. In the case with inefficiency ($\alpha < \alpha^{\dagger}$), the welfare losses increase as the fraction of sophisticates increases; in this case sophisticates do not consume the (high-priced) add-on.

III. Extensions

In this section we discuss several extensions of the model. First, we discuss the case in which myopes learn to become sophisticates. Second, we analyze the case of continuous demand for the add-on. Finally, we discuss a series of additional considerations that influence the persistence of shrouding.

III.A. Learning

In some markets, myopes eventually learn the high price of the add-on, thereby becoming sophisticates. We present an extension that reflects this learning process and demonstrate how learning affects equilibrium pricing.

We adopt the same timing as before, but now we assume that the decision about add-on consumption is repeated. Specifically, after choosing a firm from which to buy the base-good, sophisticates face the add-on purchase decision T_S times. For each decision, sophisticates decide whether to pay avoidance cost e or buy the add-on for price $\widehat{p}$. Informed myopes act just like sophisticates. Uninformed myopes buy the add-on T_{MM} times.[37] They then become sophisticates and make sophisticated choices T_{MS} times.[38] Our original model corresponds to $T_S = T_{MM} = 1$ and $T_{MS} = 0$.[39] We assume that firms choose their shrouding policies and prices once and for all and do not change them during the game.

The following Proposition shows that there is a Shrouded Prices Equilibrium if the fraction of sophisticates α is low.

[36] This assumption is made without loss of generality.

[37] In practice, the propensity to become sophisticated should increase with the cost of behaving myopically. This would lead to an interesting extension of the framework.

[38] In some cases is may be natural to assume $T_S = T_{MM} + T_{MS}$, but we do not make this assumption here, the Shrouded Prices Equlibrium does not depend on it.

[39] See Miao [2005] for another analysis.

Proposition 3 Let

$$\alpha^{\dagger\dagger} \equiv 1 - \frac{e}{\overline{p}} \frac{\max\left(T_S, T_{MM} + T_{MS}\right)}{T_{MM}}. \tag{7}$$

If $\alpha < \alpha^{\dagger\dagger}$, then there exists a symmetric equilibrium in which firms shroud the add-on pricing. Call this the Shrouded Prices Equilibrium:

$$\begin{aligned} p &= -(1-\alpha)\,\overline{p} T_{MM} + \mu \\ \widehat{p} &= \overline{p}. \end{aligned} \tag{8}$$

In this equilibrium the myopes purchase the add-on until they become sophisticates. The allocation is socially inefficient since sophisticates substitute away from the add-on. The beliefs of sophisticated consumers and educated myopes are $\widehat{p} = \overline{p}$ for the add-on price at firms that shroud.

The myopia model predicts that consumers will eventually learn to avoid add-on fees. Agarwal *et al.* [2005] empirically evaluate these dynamics, confirming the prediction that add-on fees in banks decline with customer tenure. This learning pattern is inconsistent with the predictions of a classical price discrimination model of add-on pricing.

Our analysis raises the question of long-run dynamics. If consumers learn to avoid add-on fees, does shrouding eventually vanish along with high add-on prices? Several countervailing forces may sustain shrouding in the long-run. First, new generations of myopic consumers enter the market. Second, sophistication is sometimes overturned by forgetting or distraction, particularly when the absolute costs of the add-on are small. Third, and most importantly, new shrouding techniques endogenously evolve. For example, the emphasis on fee-based revenue in the banking sector is a recent development [Rogers and Sinkey 1999]

We believe that fees for specific add-ons have a lifecycle. When the add-on is new it tends to be shrouded and priced above marginal cost. Over time, shrouding decreases and the add-on price falls. Using our notation, the fraction α of sophisticates increases over time and shrouding eventually disappears.[40]

[40] We thank Douglas Bernheim for suggesting these lifecycle dynamics.

III.B. Continuous add-on demand

In this section, we generalize the model to the case of continuous demand for the add-on. We show that equilibrium shrouding survives only when sophisticates have relatively inexpensive substitutes for the add-on. The structure and timing of the game in this section mirrors the details of the original game except for the extensions enumerated below.

Total consumer utility is decomposed into two parts: the value of owning the base good and the cost of purchasing — or substituting away from — the add-on. Let u_{ai} represent agent a's value of firm i's *base good*, overlooking the add-on.[41] Let $\widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right) - \widehat{p}_i \widehat{q}_{ai}$ represent the costs associated with the add-on, reflecting both the add-on quantity $\widehat{q}_{ai}$ and any costly efforts $\widehat{e}_{ai}$ to substitute away from the add-on. The leading case is $\partial^2 \widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right) / \partial \widehat{e}_{ai} \partial \widehat{q}_{ai} \leq 0$. The net value of buying the base good can be written

$$\underbrace{u_{ai} - p_i}_{\text{base good utility}} + \underbrace{\widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right) - \widehat{p}_i \widehat{q}_{ai}}_{\text{add-on utility}}.$$

In period 1, sophisticated consumer a picks a firm i and substitution effort $\widehat{e}_{ai}$ to maximize

$$U_{ai} = u_{ai} - p_i + \max_{\widehat{e}_{ai}} E\left\{\max_{\widehat{q}_{ai}}\left[\widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right) - \widehat{p}_i \widehat{q}_{ai}\right]\right\}.$$

In period 2, sophisticates pick $\widehat{q}_{ai}$ to maximize $\widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right) - \widehat{p}_i \widehat{q}_{ai}$. We call $\widehat{u}^S\left(\widehat{p}_i\right) = \widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right)$ the corresponding indirect utility for the rational expectations case in which $\widehat{p}_i = E\widehat{p}_i$.[42]

Informed myopes behave just like sophisticates, since informed myopes observe the add-on information in period 1.

In contrast, uninformed myopes do not take account of the add-on when they pick a firm i. In period 1, uninformed myopes pick a firm i to maximize $u_{ai} - p_i$.

Uninformed myopes passively choose a default level of substitution effort in period 1 $\widehat{e}_{ai}^M$ which is not responsive to shrouded variation in $\widehat{p}_i$. In period 2, uninformed myopes pick $\widehat{q}_{ai}$ to maximize $\widehat{u}\left(\widehat{e}_{ai}^M, \widehat{q}_{ai}\right) - \widehat{p}_i \widehat{q}_{ai}$.

We call c the the marginal cost of the base good and $\widehat{c}$ the marginal cost of manufacturing the add-on. Let $\widehat{q}^S\left(\widehat{p}\right)$ represent the equilibrium add-on demand of a sophisticate who knows she will face a price $\widehat{p}$. Let $\widehat{q}^M\left(\widehat{p}\right)$ represent the equilibrium add-on demand of an uninformed myopic

[41] For example u_{ai} could represent the value of the base good assuming a zero price for the add-on.

[42] $\widehat{u}^S\left(\widehat{p}_i\right) = \widehat{u}\left(\widehat{e}_{ai}, \widehat{q}_{ai}\right) = \widehat{u}\left(\widehat{e}_{ai}(E\widehat{p}_i), \widehat{q}_{ai}(\widehat{e}_{ai}(E\widehat{p}_i), \widehat{p}_i)\right) = \widehat{u}\left(\widehat{e}_{ai}(\widehat{p}_i), \widehat{q}_{ai}(\widehat{e}_{ai}(\widehat{p}_i), \widehat{p}_i)\right)$.

who initially overlooks add-on prices because they are shrouded. We assume that there is a unique monopoly price in the add-on market, given by

$$\widehat{p}^m = \arg\max_{\widehat{p}} (\widehat{p} - \widehat{c}) \left[\alpha \widehat{q}^S (\widehat{p}) + (1-\alpha)\, \widehat{q}^M (\widehat{p})\right]. \tag{9}$$

Now we characterize symmetric sequential equilibria.

Proposition 4 Suppose that unshrouding makes all consumers sophisticated ($\lambda = 1$). The price vector

$$p = c - (\widehat{p} - \widehat{c})\, \widehat{\widehat{q}}\,(\widehat{p}) + \mu \tag{10}$$

$$\widehat{p} = \widehat{p}^m \tag{11}$$

supports a Shrouded Prices Equilibrium if and only if $B \geq 1$, where B is the debiasing ratio:

$$B = \frac{\text{cross-subsidy to sophisticates from myopes}}{\text{loss of social surplus (for sophisticate demand) due to add-on mark-up}} \tag{12}$$

$$= \frac{(1-\alpha)\left(\widehat{p}^m - \widehat{c}\right)\left(\widehat{q}^M (\widehat{p}^m) - \widehat{q}^S (\widehat{p}^m)\right)}{\left[\widehat{u}^S (\widehat{c}) - \widehat{c}\widehat{q}^S (\widehat{c})\right] - \left[\widehat{u}^S (\widehat{p}^m) - \widehat{c}\widehat{q}^S (\widehat{p}^m)\right]} \tag{13}$$

The beliefs of sophisticated consumers and educated myopes are $\widehat{p} = \widehat{p}^m$ for the add-on price at firms that shroud.

The proof is in Appendix 2.

This no-advertising result contains a boundary condition that determines when advertising will appear: $B \geq 1$.[43] Advertising does not arise when the cross-subsidies to sophisticates are larger than the *social* welfare distortions due to price deviations from marginal cost. An empirical test of this theory would calculate B ratios in different markets, and determine whether markets with high B values tend to be more shrouded.

To heuristically derive the result, consider another ratio that is easier to directly interpret:

$$B' = \frac{\text{loss-leader subsidy in base-good market}}{\text{loss of consumer surplus (for sophisticate demand) due to add-on mark-up}} \tag{14}$$

$$= \frac{\left(\widehat{p}^m - \widehat{c}\right)\left[\alpha \widehat{q}^S (\widehat{p}^m) + (1-\alpha)\, \widehat{q}^M (\widehat{p}^m)\right]}{\left[\widehat{u}^S (\widehat{c}) - \widehat{c}\widehat{q}^S (\widehat{c})\right] - \left[\widehat{u}^S (\widehat{p}^m) - \widehat{p}^m \widehat{q}^S (\widehat{p}^m)\right]} \tag{15}$$

[43] With the discrete demand model of section 2, the subsidy is $(1-\alpha)\,\overline{p}$, the distortion is e, so $B = B' = (1-\alpha)\,\overline{p}/e$. Condition $B \geq 1$ is $\alpha \leq \alpha^\dagger$, reproducing the result of Proposition 1.

A sophisticate at a shrouded firm will not defect to a marginal cost pricing firm if the loss-leader subsidy in the base-good market exceeds the *consumer* welfare gain from switching to marginal cost pricing in the add-on market (i.e., $B' \geq 1$). Since aftermarket profit generates loss-leader competition in the base-good market, the loss-leader base-good subsidy is $(\widehat{p}^m - \widehat{c}) \left[\alpha \widehat{q}^S (\widehat{p}^m) + (1-\alpha) \widehat{q}^M (\widehat{p}^m)\right]$, which is the average profit per customer in the add-on market. The denominator of B' is the sophisticates' welfare loss from high mark-ups in the add-on market. At marginal cost pricing ($\widehat{p} = \widehat{c}$), the sophisticate would realize add-on utility of $\widehat{u}^S (\widehat{c}) - \widehat{c}\widehat{q}^S (\widehat{c})$, but in the shrouded prices equilibrium the sophisticate pays add-on price $\widehat{p}^m$ and realizes a lower add-on utility of $\widehat{u}^S (\widehat{p}^m) - \widehat{p}^m \widehat{q}^S (\widehat{p}^m)$. Putting these results together, we get the expression of B' in equation 15. We can recover B (equation 13) by subtracting $(\widehat{p}^m - \widehat{c}) \widehat{q}^S (\widehat{p}^m)$ from both the numerator and denominator of B'. Hence $B \geq 1$ iff $B' \geq 1$.

III.C. Additional models of shrouded equilibria

In this subsection, we discuss some tractable variants of our model that are empirically relevant. One variant is that of "observable prices but limited awareness."[44] In this version, the prices of all firms are always observable, at no cost, by all consumers. Myopes, however, just do not consider (or even think of) the price of the add-on. In contrast, sophisticates costlessly observe and take into account the add-on prices of all firms. If a firm "unshrouds," it educates the myopes (or a fraction λ of them), and makes them aware of the existence of the add-on. The results of this variant are very close to the results of the present framework. The results of Proposition 1 – the discrete demand model – do not change. The results of Proposition 4 – the continuous demand model – do not change, except that the add-on price charged in the Shrouded Equilibrium falls between marginal cost and the monopoly price. The reason is that, if a firm lowers the price of the add-on, it gets more sophisticated consumers.

In another variant, myopic consumers simply underestimate their use of the add-on.[45] This variant is relevant when consumers are overoptimistic about the use of credit cards [Ausubel 1991] or lines of credit [Landier and Thesmar 2005]. Such a microfoundation would not change the results of the present paper.

The model also makes predictions about which attributes will be shrouded, for a given good. Indeed, one can generalize the model to a good with several shrouded attributes, which may have

[44] This variant is developed in the May 2004 version of the present paper, which is available upon request.
[45] Section 7.3 of our 2004 working paper.

different values for α, e and $\overline{p}$. Our Proposition 1 also applies to each attributes. There will be a Shrouded Prices Equilibrium for an attribute if $\alpha < 1 - e/\overline{p}$ for that attribute. Hence an attribute will be shrouded if its debiasing ratio $B = (1-\alpha)\,\overline{p}/e$ is greater than 1.

III.D. Other influences on shrouding

To simplify exposition, we have ignored several additional factors that influence the prevalence of shrouding. In this subsection, we quickly discuss these factors, starting with the factors that encourage shrouding. First, we have so far overlooked the consumer entry decision, since we have assumed that all consumers must buy a base good. When some consumers overlook add-on costs, these myopic consumers may buy the base good when they should *avoid* the market altogether [Ellison 2005]. Think of a consumer who buys a $50 deskjet printer without realizing that the lifetime operating costs are at least ten times higher.[46] Firms that compete by unshrouding high add-on prices will drive some of these myopic consumers out of the base-good market. Hence, consumer entry decisions are adversely affected by unshrouding [Spence 1977].

Second, we have so far assumed that once a consumer becomes informed about the costly add-on at *one* firm, that consumer takes account of the costly add-ons at *all* firms. However, it is instead possible that unshrouding by one firm leads consumers only to think about the unshrouded add-on at that single firm. This narrow framing effect would impede unshrouding.

Third, if education/advertising is costly, then unshrouding will again be impeded. Specifically, suppose there is a fixed cost C of unshrouding. Then Proposition 4 is adjusted so that a Shrouded Prices Equilibrium exists iff $B \geq 1$, where B is defined as before except the numerator of B is incremented by kC, where $k = 1$ if $\mu = 0$ and k equals the number of firms if μ is very large.[47] Analogously Proposition 1 is adjusted so that a Shrouded Prices Equilibrium exists iff $(1-\alpha)\overline{p}+kC > e$. This implies that shrouding is more pervasive when the market is less competitive.

Fourth, we have already mentioned that learning will accelerate unshrouding. However, innovation will create new add-ons and new opportunities for shrouding.

Some forces besides learning, however, will favor unshrouding. For instance, if consumers have heterogeneous tastes and firms have heterogeneous add-ons, firms will advertise to enable con-

[46] At the moment, black and white text costs between 2 cents and 15 cents per page, depending on the inkjet printer. Color text costs more than black and white text. A photographic image costs an order of magnitude more. Printing 10 pages per day at only 10 cents a page costs $1460 over four years.

[47] The proof is a simple modification of the proofs of Propositions 1 and 4, with a Taylor expansion when μ is very large.

sumers to find the base-good with the right add-on. This informative advertising will accelerate unshrouding.

Also, third party consumer education — e.g., magazines like *Consumer Reports* — will accelerate unshrouding. However, various impediments prevent such educational mechanisms from working perfectly. Non-profit educational organizations may be underfinanced. Moreover, for-profit educational organizations may have incentives to give bad advice. For example, personal finance magazines tend to recommend active portfolio management, thereby justifying ongoing demand for these magazines. Consumers may not know which advisor to trust.

IV. Measuring and regulating shrouding

In this section we discuss the measurement and regulation of shrouding. We first consider the problem of a regulator — or an economic researcher — who wishes to empirically identify the existence of shrouding. We then consider potential regulatory remedies, emphasizing both the benefits and pitfalls of these policies.

IV.A. Measuring shrouding: diagnostics

Five different empirical strategies can be used to identify the existence of shrouding. First, researchers may conduct consumer surveys. Such surveys would determine whether consumers at the point of purchase are aware of the add-on costs that they will later face. This corresponds to measuring α, an index of average "consumer I.Q." For example, Hall [2003] finds that only 3% of consumers who buy desk-jet printers know the associated ink costs at the time they purchase the printer.[48] Of course, such ignorance may or may not imply shrouding (e.g. ignorance may result from exogenously high search costs). Consumer surveys might also test for incorrect consumer expectations. For example, at the point of purchase consumers could be asked to estimate their ink costs. In shrouded equilibria, a large fraction of consumers should underestimate such costs (and relatively few consumers should overestimate those costs). Naturally, whenever possible, surveys should use incentive compatible designs. For example, respondents could be told to estimate the ink costs of a consumer who prints a specific number of pages per month and uses non-generic cartridges. With such a set-up, accurate beliefs could be financially rewarded.

[48] Office of Fair Trading [2002] provides related evidence.

Second, researchers could test comparative statics assumed or predicted by the model. The model assumes that consumers show a greater response to up-front costs than to delayed costs. More generally, the model assumes that consumers show a relatively muted response to complex, contingent, camouflaged, distant, or disaggregated costs. Hausman [1979] and Hausman and Joskow [1982] find that consumers are far more responsive to the store prices of appliances (e.g. refrigerators) than to the net present value of the energy costs of operating the appliances. Barber, Odean and Zheng [forthcoming] show that mutual fund investors are more sensitive to front-end loads than to ongoing management fees. Hossain and Morgan [2005, 2006] find that consumers are more responsive to direct costs than to shipping charges, and more generally find field evidence for shrouded attributes. Researchers could also study comparative statics by conducting controlled experiments. A control group might receive standard (shrouded) marketing materials. A treatment group would see the standard marketing material as well as an unshrouded statement of the add-on costs. Choi et al. [2005] conduct a field experiment with the structure above. They find that MBA students avoid investing in mutual funds with high management fees only when those fees are explicitly unshrouded with an exogenous intervention.

Third, researchers could also determine whether firms gratuitously increase the search cost for add-on prices. For instance, firms may make add-on prices much harder to find than other less important information.

Fourth, researchers may conduct product audits, which determine if base goods are being sold at loss-leader prices and if add-ons are being sold at high mark-ups. Of course, loss-leader base goods and high markups on add-ons are only necessary conditions for the existence of a shrouded equilibrium.

Fifth, regulators could look for learning effects implied by shrouded equilibria. If fees are initially shrouded and consumers encounter these fees as they gain more experience with a product, then consumers will slowly learn to avoid these fees (see section III.A). Indeed, the logic of shrouding implies that learning effects may generate reduced form preference reversals. For example, consider two bank account holders: one consumer just triggered an add-on fee and the other consumer did not. The consumer who just "bought" the add-on will have a lower future add-on demand compared to the consumer who did not buy the add-on (since the latter consumer has a higher chance of still being unaware of the add-on trap). Such dynamic demand reversals contradict standard theories of add-on demand, which feature consumer heterogeneity and price discrimination. Agarwal et al. [2005] find learning effects in the retail banking market. Other authors have argued that consumers

with a better general education get better prices in the marketplace. Woodward [2003] finds that more educated consumers pay less in the mortgage market controlling for default risk. Controlled field experiments can be designed to identify the effect of unshrouding.

IV.B. Regulatory interventions

Shrouded equilibria generate economic inefficiencies. However regulatory remedies may not be available. It is difficult to outlaw ignorance or misleading (but accurate) marketing. If regulators find evidence for inefficient shrouding, they have four types of (imperfect) regulatory remedies that they might consider employing. Of course, the usual costs of regulation could easily outweight its possible benefit.

First, regulators may compel disclosure. For example, regulators could compel printer manufacturers to report the cost of ink of printed page in a prominent place on the product. Indeed, regulators have occassionally adopted such unshrouding policies (e.g. nutrtitional labelling, energy usage labelling, and financial product labelling). However, disclosure laws for credit cards and mortgages have met with only mixed success [Ausubel 1991, Woodward 2003]. Indeed, in most markets it is difficult to design and enforce a successful disclosure regulation. For example, how would one compel banks to make financial service fees salient? A bank account provides access to thousands of complementary financial services with associated fees (e.g., out-of-network ATM fees, overdraft fees, bounced check fees, etc). There is no summary statistic like ink cost per page that summarizes bank fees. Regulations will probably not succeed if they simply change the font size of the fine print. Nobody yet knows how to compel transparency. And it remains to be seen whether that is desirable — or possible — in practice.

Second, regulators could simply warn consumers to pay attention to shrouded costs. For example, required "warning labels" could be placed prominently on marketing materials, much like cigarette warning labels. For example, mutual fund marketing materials could be required to contain the following warning label: "Investors are urged to check loads, management fees, and other charges before investing in any mutual fund. If these fees are not reported in marketing materials, do not forget to ask about them."[49]

Third, regulators could make add-on markets more competitive. For example, regulators could require that printer manufacturers allow competitive entry in the printer cartridge market.

[49]The U.K. Treasury is in the midst of a broad expansion of transparency regulation in the banking sector [Cruickshank 2000].

Right now, most printer manufacturers prevent such entry by designing cartridges with integrated patented printer heads (instead of incorporating the printer head into the printer itself). Hall [2003] contains an analysis of this anti-competitive practice. The famous Kodak copier case [Klein 1993] presents another example of an add-on market in which competition was effectively eliminated, resulting in a supreme court decision against the aftermarket monopoly. However, we tend to be skeptical of regulations that prevent companies from exerting market power. Such pro-competitive regulations may have the unintended negative consequence of discouraging technological innovation.

Finally, regulators may impose markup caps on shrouded attributes.. For example, Singapore regulates the mark-up the hotel charge for phone.[50] However, even if good theoretical arguments exist for regulating shrouded fees, such regulations put us on a slippery slope that may produce great unintended harm. Mark-up regulations are often counterproductive.

V. Conclusion

Firms often shroud the negative attributes of their products, particularly high prices for complementary add-ons. Following a suggestion by Ellison [2005], we present a model of consumer myopia that explains such shrouding. We identify conditions under which shrouding survives in competitive equilibrium. We show that competition will not induce firms to reveal information that would improve market efficiency. Firms will not educate the public about the add-on market, even when unshrouding is free.

A "curse of debiasing" suppresses unshrouding. Debiasing a consumer improves consumer welfare, but no firm can capture or even partially share these benefits. Firms receive lower profits when they interact with debiased consumers. Debiased consumers know how to avoid high-priced items. Moreover, firms can't drive away such debiased consumers without losing (profitable) myopic consumers as well. Debiased consumers can pretend to be myopes, enabling the debiased consumers to take advantage of the traps that firms set for myopes.

The economics of shrouding suggest some new research questions. We would like to measure the scope of firms' efforts to shroud information. We would like to measure the degree of consumer myopia. Finally, we would like to know how quickly learning unshrouds information and how quickly the fog returns as firms introduce new products and "better" marketing techniques.

[50] Singapore requires that hotels price their international phone calls at marginal cost, plus a maximum of 30 Singaporean cents (which is about 20 U.S. cents).

Appendix 1: The Demand Function $D(x)$

We define $D(x)$ as the demand of a firm that offers an average perceived surplus x units greater than the average perceived surplus provided by its competitors. We develop the microfoundations for $D(x)$ using random utility theory (see Anderson, de Palma and Thisse [1992] for an excellent review). We assume that good i gives agent a decision utility equal to $U_{ai} = v_i - p_i + \varepsilon_{ai}$, where ε_{ai} is i.i.d. across firms i and agents a, with cumulative distribution function F and density $f = F'$. We interpret ε_{ia} as a tremble or an idiosyncratic consumer preference [McFadden 1981]. We normalize the mass of consumers to 1. The demand for firm i is thus: $D_i = P(v_i - p_i + \varepsilon_{ai} \geq \max_{j \neq i} v_j - p_j + \varepsilon_{aj})$. We will be looking for symmetric equilibria where a firm posts quality v and prices p, while the other firms post the same quality v^* and price p^*, and all firms have the same σ. In those cases, one can set $S = v - p$ and $S^* = v^* - p^*$, introducing short-hand for the net average surpluses. Then the demand for firm 1 is $D_1 = D(S - S^*)$, where we define

$$D(x) \equiv P\left(x + \varepsilon_1 \geq \max_{j=2...n} \varepsilon_j\right) = \int_{-\infty}^{\infty} f(\varepsilon) F^{n-1}(x + \varepsilon) \, d\varepsilon. \tag{16}$$

See Perloff and Salop [1985] or Anderson, de Palma and Thisse [1992]. The demand depends only on the difference $S - S^*$ between the surplus S offered by the firms, and the surplus S^* offered by its competitors. The following Proposition characterizes the symmetric equilibrium.

Lemma 1 Suppose that $\ln f$ is concave, and that firms compete in prices, and have identical costs c and values v, so that the profit of a firm charging p is $(p - c) D(p^* - p)$. Then there is a unique symmetric equilibrium with $p - c = \mu := D(0) / D'(0)$. Also,

$$\mu D(0) = \max_x x D(-x + \mu). \tag{17}$$

Proof of Lemma 1. The existence of the symmetric equilibrium is guaranteed by Caplin and Nalebuff [1991], Theorem 2 and Proposition 7. If marginal costs are c and profits are $(p - c) D(p^* - p)$, the first order condition is $D(p^* - p) - (p - c) D'(p^* - p) = 0$. In the symmetric equilibrium, $p = p^*$ and so $p - c = \mu$. Finally, equation 17 just reflects that a price $p = p^* = \mu$ is an equilibrium if $c = 0$.

A few cases have compact closed forms. If the noise is Gumbel distributed, i.e. $F(\varepsilon) = \exp(-e^{-\varepsilon})$, the demand is logistic: $D(x) = 1/[1+(n-1)e^{-x}]$. If the noise is exponentially distributed with density $e^{-\varepsilon}1_{\varepsilon>0}$, the demand is $D(x) = e^x\left[1 - 1_{x\geq 0}(1-e^{-x})^n\right]/n$. If the noise is uniformly distributed in $[-1/2, 1/2]$, then $D(x) = 0$ for $x < -1$, $D(x) = (1+x)^n/n$ for $x \in [-1, 0]$, $D(x) = x + (1-x^n)/n$ if $x \in [0, 1]$, and $D(x) = 1$ for $x > 1$.

Appendix 2: Longer Derivations

Proof of Proposition 1. The timeline is detailed in section II. We specify the sequential equilibrium of the game. We use the terminology from Fudenberg and Tirole [1991, pp.337-341]. We call p^* and $\widehat{p}^*$ the equilibrium prices at other firms for the base good and the add-on respectively, and we call p and $\widehat{p}$ the prices at firm i. We call $\widetilde{\widehat{p}}$ and $\widetilde{\widehat{p}}^*$ the beliefs of the sophisticated consumers about add-on prices. We need to check sequential rationality and consistency of the beliefs and actions. If a firm unshrouds $\widehat{p}$, then the sophisticated consumers know $\widehat{p}$, which pins down their belief. If a firm shrouds $\widehat{p}$, then sophisticated consumers rationally believe that the firm will charge the monopoly price in period 2: $\widetilde{\widehat{p}} = \overline{p}$, as this is the profit maximizing price for the firm that shrouds. Given the belief $\widetilde{\widehat{p}} = \overline{p}$, the sequentially rational action for the sophisticated consumers is to exert the effort e. Hence sequential equilibrium very simply characterizes the beliefs of sophisticated consumers and the newly educated myopes, who behave exactly like sophisticated consumers. The beliefs of the myopes do not matter, as they just pick with equal probability a firm amongst the firms who charge the lowest base good prices.

We now check that firm i does not want to deviate from the announced strategies.

Case 1: $\alpha < \alpha^\dagger$ and the Shrouded Prices Equilibrium.

- Firm i can shroud and pick p and $\widehat{p}$. Its profit is equal to

$$\pi = \left(p + (1-\alpha)\,\widehat{p}1_{\widehat{p}\leq\overline{p}}\right) D(p^* - p),$$

as the beliefs are $\widetilde{\widehat{p}} = \widetilde{\widehat{p}}^* = \overline{p}$ and the demand for the base good of all the consumers depends only on $p^* - p$. This profit is clearly maximized when $\widehat{p} = \overline{p}$ so that

$$\pi = (p + (1-\alpha)\overline{p})\, D(p^* - p).$$

The base good price p that solves the first order condition $-(p+(1-\alpha)\overline{p})\,D'(p^*-p)+D(p^*-p)=0$ for $p=p^*$ is $p=p^*=-(1-\alpha)\overline{p}+\mu$.

- Firm i can unshroud and pick p and $\widehat{p}$. By unshrouding its add-on price, firm i educates some of the myopes and the fraction of sophisticates becomes $\alpha'=\alpha+\lambda(1-\alpha)$. The myopes keep ignoring the price of the add-on when deciding to buy the add-on while the sophisticates incorporate it and will buy it iff $\widehat{p}\leq e$.

  - If $\widehat{p}\leq e$

$$\pi=\alpha'\,(p+\widehat{p})\,D(-p-\widehat{p}+p^*+e)+(1-\alpha')\,(p+\widehat{p})\,D(p^*-p),$$

    which is maximized when $\widehat{p}=e$. Otherwise firm i can increase $\widehat{p}$ by a small positive increment, decrease p by the same increment, and not change the demand of sophisticated consumers while increasing strictly the demand of naive consumers. Hence, the profit can be reexpressed:

$$\pi=(p+e)\,D(p^*-p).$$

    As $\alpha<\alpha^\dagger$, this profit is smaller than $(p+(1-\alpha)\overline{p})\,D(p^*-p)$, the profit firm i could achieve by choosing to shroud and price at p and $\widehat{p}=\overline{p}$.

  - If $\widehat{p}>e$,

$$\pi=\left(p+(1-\alpha')\widehat{p}1_{\widehat{p}\leq\overline{p}}\right)D(p^*-p),$$

    which is strictly smaller than $(p+(1-\alpha)\overline{p})\,D(p^*-p)$, the profit firm i could achieve by choosing to shroud and price at p and $\widehat{p}=\overline{p}$.

  - We conclude that the best response of firm i is to shroud and price at $p=p^*=-(1-\alpha)\,\overline{p}+\mu$ and $\widehat{p}=\widehat{p}^*=\overline{p}$.

Case 2: $\alpha^\dagger<\alpha$ and the Unshrouded Prices Equilibrium.

- Firm i can unshroud and pick p and $\widehat{p}$.

  - If $\widehat{p}\leq e$,

$$\pi=\alpha'\,(p+\widehat{p})\,D(-p-\widehat{p}+p^*+e)+(1-\alpha')\,(p+\widehat{p})\,D(p^*-p),$$

    which is maximized when $\widehat{p}=e$. Otherwise firm i can increase $\widehat{p}$ by a small positive increment, decrease p by the same increment, and not change the demand of so-

phisticated consumers while increasing strictly the demand of naive consumers. Hence $\pi = (p+e)\,D(p^* - p)$. In equilibrium, the base good price p solves the first order condition, $-(p+e)\,D'(p^* - p) + D(p^* - p) = 0$. This implies that $p = p^* = -e + \mu$.

– If $\widehat{p} > e$, only myopes buy the add-on, and

$$\pi = \left(p + (1-\alpha')\widehat{p}1_{\widehat{p}\leq\overline{p}}\right) D(p^* - p).$$

This profit is clearly maximized when $\widehat{p} = \overline{p}$. The profit is $\pi = (p + (1-\alpha')\overline{p})\,D(p^* - p)$, which is strictly smaller than $(p+e)\,D(p^*-p)$, the profit firm i could achieve by choosing to unshroud and price at p and $\widehat{p} = e$.

- Firm i can shroud and pick p and $\widehat{p}$ and get a profit equal to

$$\pi = \left(p + (1-\alpha')\ \widehat{p}1_{\widehat{p}\leq\overline{p}}\right) D(p^* - p),$$

as the beliefs are $\widetilde{\widehat{p}} = \overline{p}$. One needs α' rather than α in the above expression, because the other firms unshroud, so they educate a fraction λ of the myopes. This profit is clearly maximized when $\widehat{p} = \overline{p}$. The profit is $\pi = (p + (1-\alpha')\overline{p})\,D(p^* - p)$, which is also strictly smaller than the profit firm i could achieve by choosing to unshroud and price at p and $\widehat{p} = e$.

- We conclude that the best response of firm i is to unshroud and price at $p = p^* = -e + \mu$ and $\widehat{p} = \widehat{p}^* = e$.

Proof of Proposition 3. We follow closely the proof of Proposition 1. The firm's optimal value $\widehat{p}$ must still be either e or $\overline{p}$. Recall that $\alpha' = \alpha + \lambda(1-\alpha)$ represents the fraction of informed consumers after unshrouding. If the firm unshrouds, its profit depends on whether $\widehat{p} = e$ or $\widehat{p} = \overline{p}$:

$$\Pi\left(\widehat{p} = e\right) = \max_p \left(p + \left[\alpha' T_S + \left(1-\alpha'\right)\left(T_{MM} + T_{MS}\right)\right] e\right) D\left(p^* - p\right), \tag{18}$$

$$\Pi\left(\widehat{p} = \overline{p}\right) = \max_p \left(p + \left(1-\alpha'\right)\overline{p}T_{MM}\right) D\left(p^* - p\right). \tag{19}$$

If it does not unshroud, its profit is

$$\Pi = \max_p \left(p + (1-\alpha)\,T_{MM}\overline{p}\right) D\left(p^* - p\right). \tag{20}$$

To compare the profits, observe that

$$\begin{aligned}\left[\alpha' T_S + \left(1-\alpha'\right)\left(T_{MM}+T_{MS}\right)\right] e &\leq \max\left(T_S, T_{MM}+T_{MS}\right) e \\ &< \left(1-\alpha\right)\overline{p} T_{MM}\end{aligned}$$

as $\alpha < \alpha^{\dagger\dagger}$. This implies $\Pi\left(\widehat{p}=e\right) < \Pi$. Unshrouding and posting a low price e for the add-on is not profitable. Also, $\Pi\left(\widehat{p}=\overline{p}\right) < \Pi$ by equation 19, 20 and $\alpha' > \alpha$. Unshrouding and posting a high price $\overline{p}$ for the add-on is also not profitable.

We conclude that whatever price the firm chooses to charge for the add-on, unshrouding is not profitable.

Proof of Proposition 4. We define the average demand in the add-on market

$$\widehat{\overline{q}}\left(\widehat{p}\right) \equiv \alpha \widehat{q}^S\left(\widehat{p}\right) + \left(1-\alpha\right)\widehat{q}^M\left(\widehat{p}\right), \tag{21}$$

In this proof, we call $p^*$and $\widehat{p}^* = \widehat{p}^m$ the equilibrium prices described in the Proposition. We check that the shrouded prices in the Proposition constitute an equilibrium.

First, it is clear that if a firm shrouds, the add-on price is the monopoly price $\widehat{p}^m$. We check that the optimal base good price is the one announced in equation 10. Without loss of generality, we take $c=0$ to simplify exposition.[51] The profits are

$$\Pi = \left(p + \left(\widehat{p}^m - \widehat{c}\right)\widehat{\overline{q}}\left(\widehat{p}^m\right)\right) D\left(-p+p^*\right).$$

If p is an equilibrium, $\partial\Pi/\partial p = 0$ at $p=p^*$. This implies $p + \left(\widehat{p}^m - \widehat{c}\right)\widehat{\overline{q}}\left(\widehat{p}^m\right) = D\left(0\right)/D'\left(0\right) = \mu$, which is equation 10.

We now calculate the profit of a firm that deviates, unshrouds, and sets new prices p and $\widehat{p}$, while the other firms keep shrouding and using the prices $p^*$and $\widehat{p}^*$ given in equations 10-11. A sophisticate facing price $\widehat{p}$ in the aftermarket gets the net utility

$$\widehat{v}\left(\widehat{p}\right) = \max_{\widehat{q},\widehat{e}} \widehat{u}\left(\widehat{e},\widehat{q}\right) - \widehat{p}\widehat{q}. \tag{22}$$

Call $\widehat{q}\left(\widehat{p}\right)$ (or $\widehat{q}^S\left(\widehat{p}\right)$ if there is an ambiguity) the associated choice of add-on demand, and $\widehat{u}\left(\widehat{p}\right) = \widehat{v}\left(\widehat{p}\right) + \widehat{p}\widehat{q}\left(\widehat{p}\right)$ the gross utility. The utility provided by the other firms is: $u^{S*} = -p^* + \widehat{v}\left(\widehat{p}^*\right)$.

[51] To go back to the general case, replace p by $p-c$.

The firm's profit is

$$\Pi = \left(p + \left(\widehat{p} - \widehat{c}\right)\widehat{q}\left(\widehat{p}\right)\right) D\left(-p + \widehat{v}\left(\widehat{p}\right) - u^{S*}\right) = xD\left(-x + \left(\widehat{p} - \widehat{c}\right)\widehat{q}\left(\widehat{p}\right) + \widehat{v}\left(\widehat{p}\right) - u^{S*}\right),$$

where $x = p + \left(\widehat{p} - \widehat{c}\right)\widehat{q}\left(\widehat{p}\right)$ is the total profit per customer. Maximizing $\Pi\left(x, \widehat{p}\right)$ over $\widehat{p}$ and noting that (22) and the envelope theorem imply $\frac{\partial}{\partial \widehat{p}}\widehat{v}\left(\widehat{p}\right) = -\widehat{q}\left(\widehat{p}\right)$, we get

$$0 = \frac{\partial}{\partial \widehat{p}}\left[\left(\widehat{p} - \widehat{c}\right)\widehat{q}\left(\widehat{p}\right) + \widehat{v}\left(\widehat{p}\right)\right] = \widehat{q}\left(\widehat{p}\right) - \widehat{q}\left(\widehat{p}\right) + \left(\widehat{p} - \widehat{c}\right)\widehat{q}'\left(\widehat{p}\right) = \left(\widehat{p} - \widehat{c}\right)\widehat{q}'\left(\widehat{p}\right).$$

This implies $\widehat{p} - \widehat{c} = 0$. When a firm faces only sophisticated consumers, it prices of the add-on efficiently. So the highest profit the firm can get after deviating is

$$\Pi = \max_{x} xD\left(-x + x^*\right), \tag{23}$$

with $x^* = \widehat{v}\left(\widehat{c}\right) - u^{S*}$.

As the pre-deviation profit is μ, the firm does not want to deviate iff

$$\Pi \leq \mu D\left(0\right), \tag{24}$$

as $\mu D\left(0\right)$ is the pre-deviation profit. Given equation 17, equation 23, and the fact that $\max_x xD\left(-x + z\right)$ is non-decreasing in z, (24) is equivalent to $x^* \leq \mu$. To find the sign of $x^* - \mu$, we calculate

$$\begin{aligned}
x^* - \mu &= \widehat{v}\left(\widehat{c}\right) - u^{S*} - \mu = \widehat{v}\left(\widehat{c}\right) - \widehat{v}\left(\widehat{p}^*\right) + p^* - \mu \\
&= \widehat{v}\left(\widehat{c}\right) - \widehat{u}^S\left(\widehat{p}^*\right) + \widehat{p}^*\widehat{q}^S\left(\widehat{p}^*\right) - \left(\widehat{p}^* - \widehat{c}\right)\widehat{\widehat{q}}\left(\widehat{p}^*\right) \text{ by (10) and (22)} \\
&= \widehat{v}\left(\widehat{c}\right) - \widehat{u}^S\left(\widehat{p}^*\right) + \widehat{p}^*\widehat{q}^S\left(\widehat{p}^*\right) - \left(\widehat{p}^* - \widehat{c}\right)\left[\alpha\widehat{q}^S\left(\widehat{p}^*\right) + \left(1 - \alpha\right)\widehat{q}^M\left(\widehat{p}^*\right)\right] \text{ by (21)} \\
&= \widehat{u}\left(\widehat{c}\right) - \widehat{c}\widehat{q}^S\left(\widehat{c}\right) - \widehat{u}^S\left(\widehat{p}^*\right) + \widehat{c}\widehat{q}^S\left(\widehat{p}^*\right) - \left(1 - \alpha\right)\left(\widehat{p}^* - \widehat{c}\right)\left(\widehat{q}^M\left(\widehat{p}^*\right) - \widehat{q}^S\left(\widehat{p}^*\right)\right) \text{ by (22).}
\end{aligned}$$

As the firm does not want to deviate iff $x^* - \mu \leq 0$, the Proposition is proven.

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